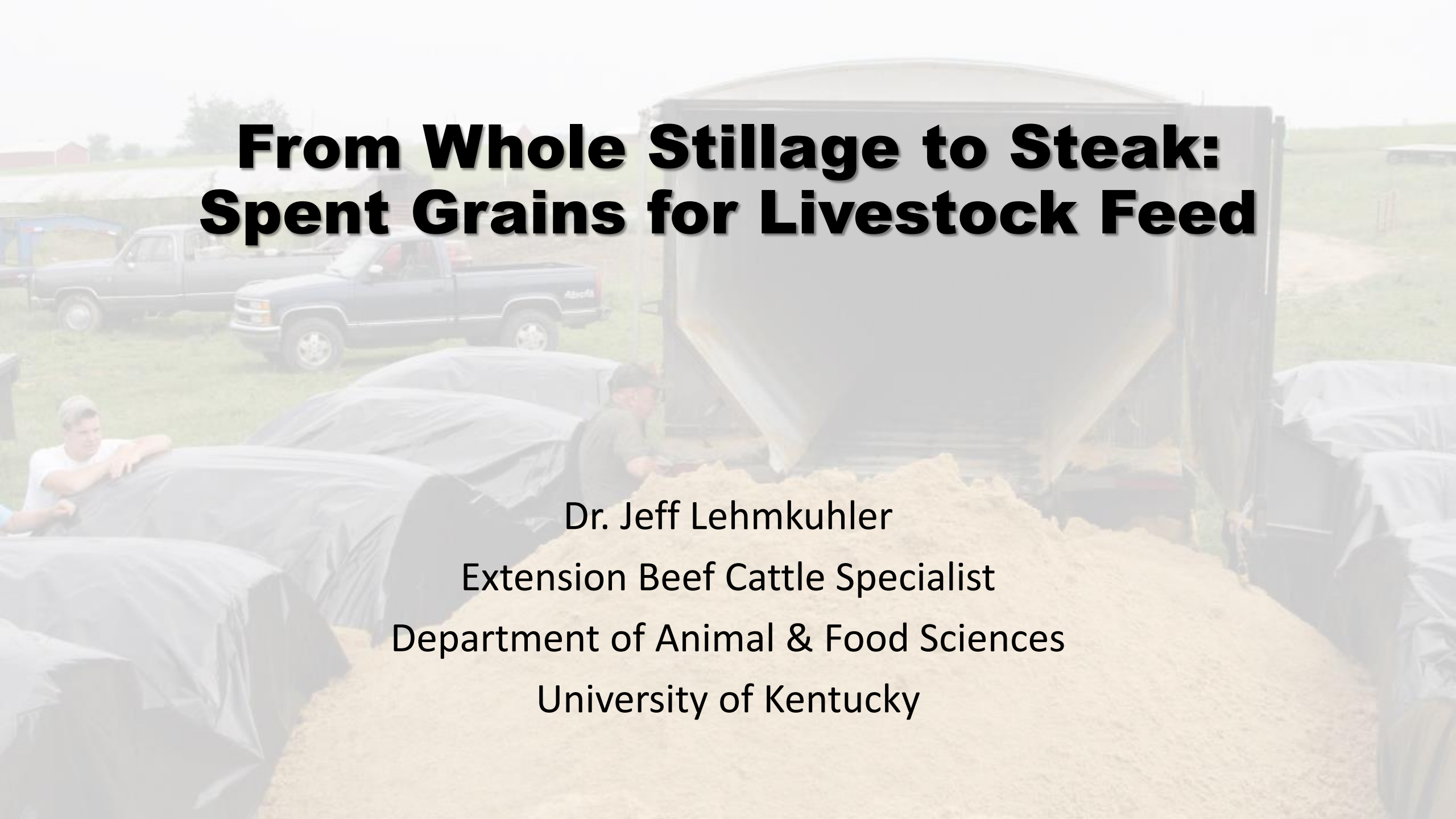
From Whole Stillage to Steak: Spent Grains for Livestock Feed



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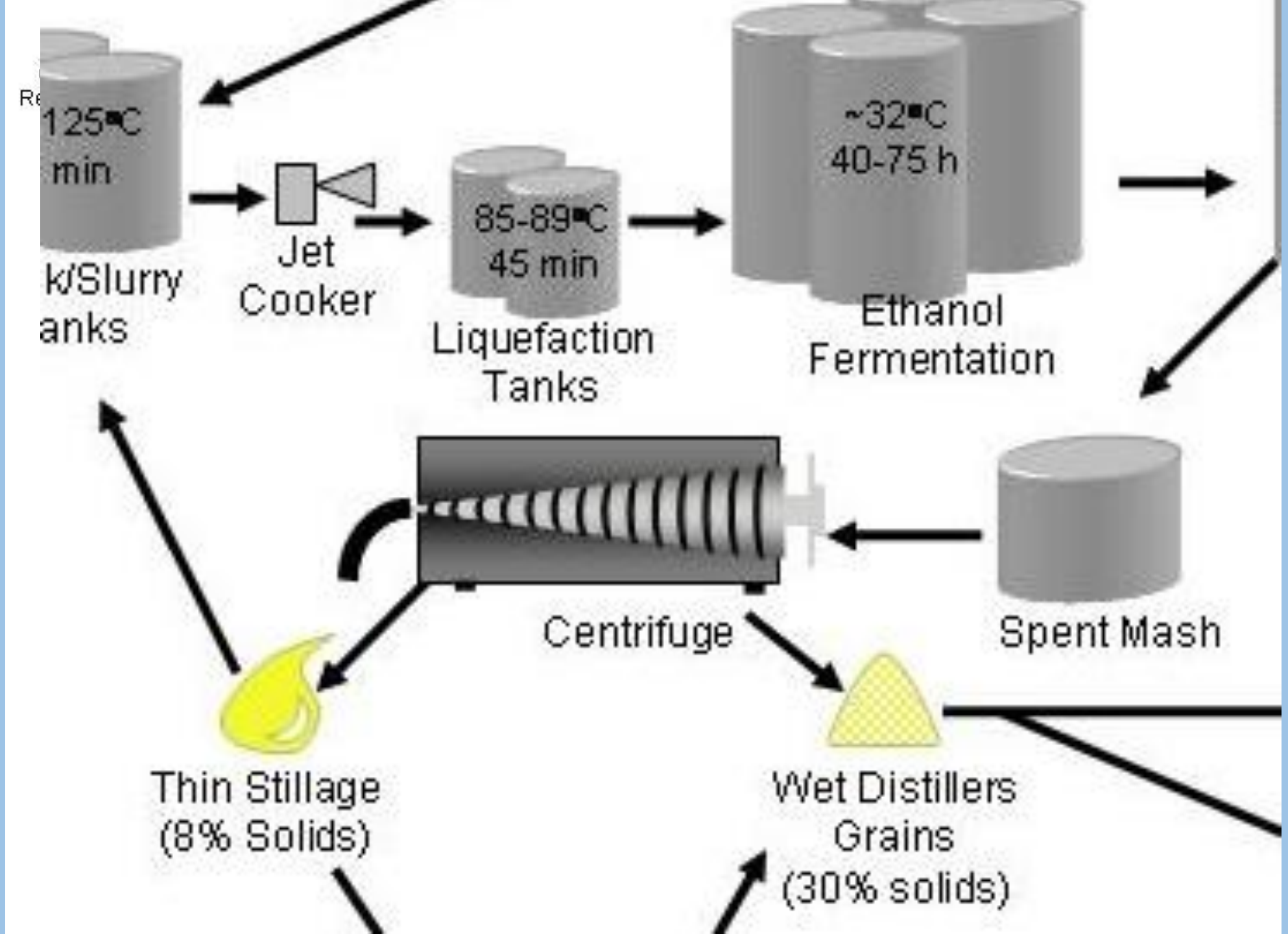
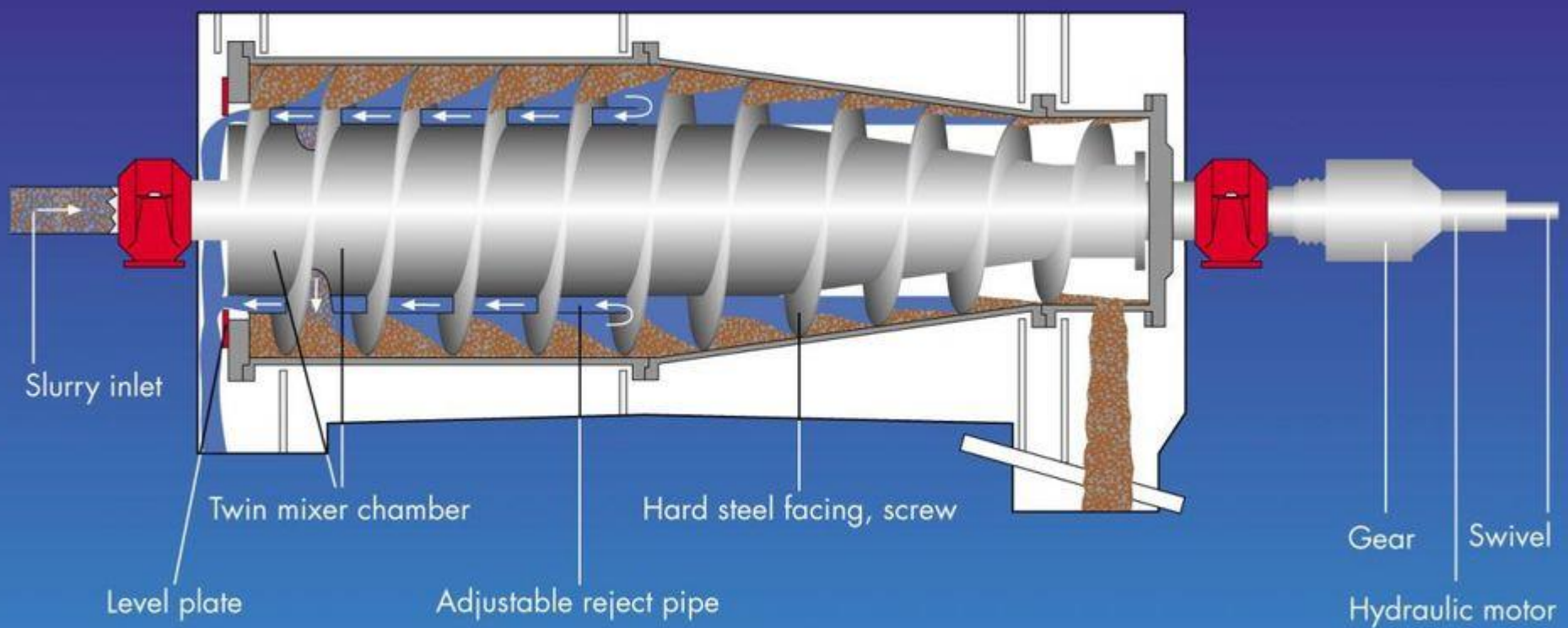

125°C
min
k/Slurry
anks
Jet
Cooker
85-89°C
45 min
Liquefaction
Tanks
~32°C
40-75 h
Ethanol
Fermentation
Centrifuge
Spent Mash
Thin Stillage
(8% Solids)
Wet Distillers
Grains
(30% solids)

Decanter centrifuge



Thin Stillage Still Present

- AFTER screwpress or centrifuge = Wet Grains + Thin Stillage
- Thin Stillage high BOD
- Evaporate to Condensed Solubles then added to wet grain
  - Drum Dryer for Dried Distillers
- Biodigestor for thin stillage?

Dewatering & Drying Options / Processes

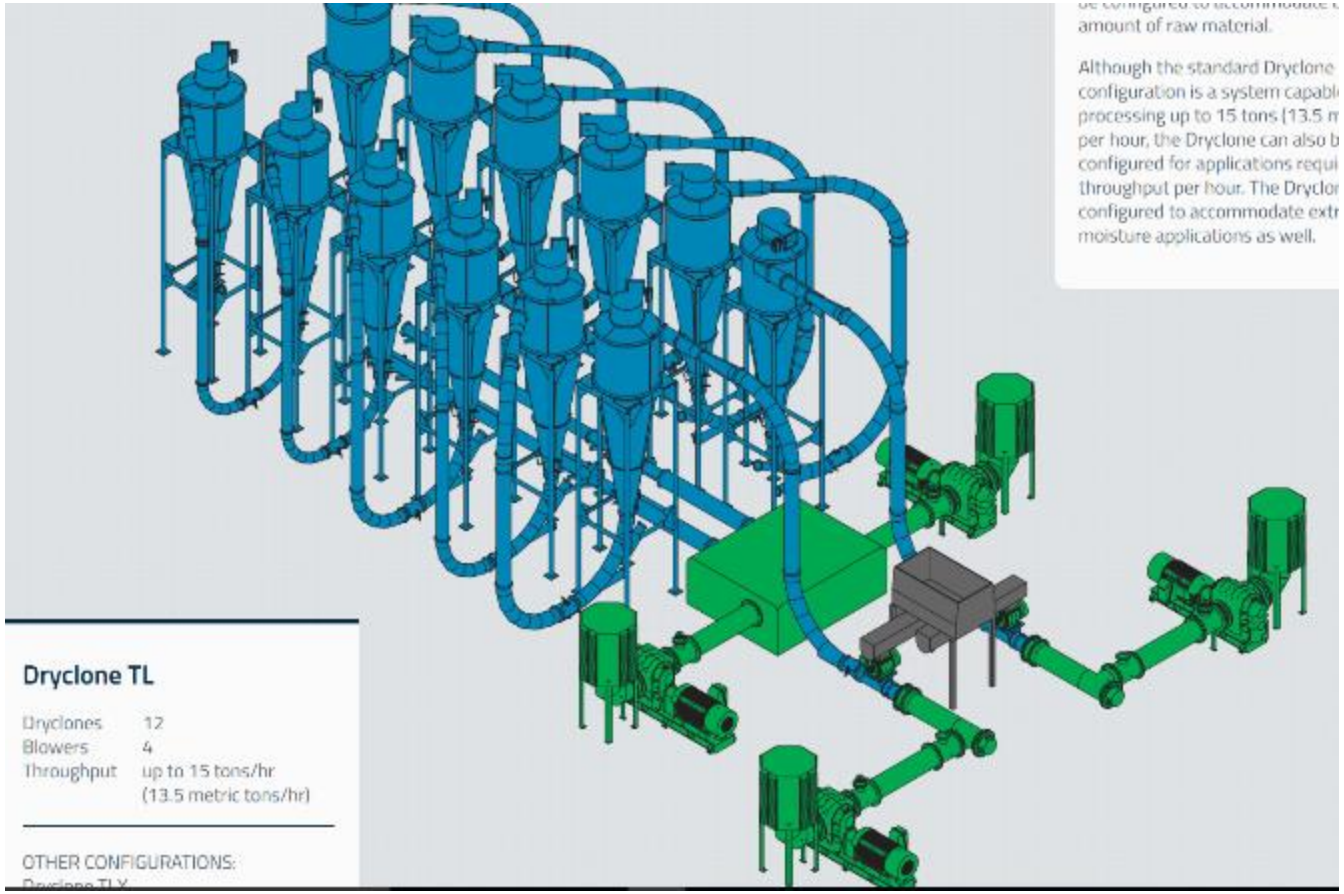
- Screw press
- Centrifuge
- Belt press
- Extruders
- Drum dryers
- Evaporators
- Sonic
- Superheated steam
- Others

Limited energy efficiency data in research

Screw press < Centrifuge

Pulverizing Air Dryer – Recently Seeking DDGS

- Non-thermal drying
- Lower energy
- No heat damage to grains
- Minimum volume?
- Throughput? 15-350 T/hr



www.dryclone.com

Selecting a Drying Process

- Initial Cost
- Consider maintenance
- Energy costs / Efficiency
- Throughput
- End moisture level / Product Stream

Analysis of Various Slop Products

Item, %DM	Thin	Settled	Whole	Evaporated
Protein, %	32.5	31.9	29.6	30
Fat, %	15	12.8	9.9	14.4
Fiber, %	5	6.4	7.4	4.4
Ca, %	0.25	0.21	0.25	0.13
P, %	1.25	1.06	0.62	1.13
Total Solids, %	4.0	4.7	8.1	16
Water, %	96	95.3	91.9	84
No. Samples	10	11	5	2

Garrigus & Good 1942 KY Ag Exp Station Report

Composition Varies by Grain source

	Wheat		Barley		Corn	
	Thin Stillage	Distillers Grains	Thin Stillage	Distillers Grains	Thin Stillage	Distillers Grains
Ash	8	4	10	4	7	5
EE	14	4	16	6	9	10
NDF	34	74	32	80	13	45
ADF	4	22	8	31	NA	NA
CP	46	26	37	15	19	30
Starch	2	2	1	1	25	8
NSC	28	7	38	4	NA	29

Mustafa, A., Mckinnon, J., Christensen, A. (2000) *Asia Australian J. Animal Sci*, 13, 1609

Stillage = Slop & Feeding Problems Occurred

- 1942 Garrigus & Good state 2 common mistakes when feeding slop

1. **Failure to use other feeds to provide a balanced ration**
2. **Hauling slop too far such that the cost makes it too expensive**

- They recommended the following
1. **½ lb / 100 lb body weight of forage / hay**
2. 3-6 lbs of grain offered to increase dry matter intake
3. Yellow ear corn for vitamin A & bloat reducing effect of the cob
4. White corn < 3 months
5. Free-choice limestone (2-3 oz/d)
6. Not more than 3-4 gal / 100 lb live weight gave farmers best results

Feeding Slop

https://youtu.be/U10D9TDYtfs

Growing Steers Thin Stillage

	0	2	4	6.7
ADG, lb	**3.5**	**3.3**	**3.7**	**3.5**
Basal Diet DMI, lb	**18.7**	**16.5**	**17.2**	**14.3**
Thin Stillage DMI, lb	**0**	**0.9**	**2.2**	**3.7**
Thin Stillage % DMI	**0**	**5.2**	**11.3**	**20.2**
Total DMI, lb	**18.7**	**17.4**	**19.4**	**18.3**
Gain:Feed TDMI	**5.3**	**5**	**5.3**	**5**

8 gal

- DM from Stillage Exchanged w/ Basal Diet
- No Detrimental Impact on Animal Performance

Fisher et al., 1999 JAS

Cattle Performance on Whole Stillage

	Thin Stillage	Water
Steers grazing crested wheatgrass		
Fluid Intake, gal/d	**12.7[a]**	**7.6[b]**
ADG, lb	**3.08[a]**	**1.98[b]**
Steers fed growing diets		
Fluid Intake, gal/d	**6.3**	**6.0**
ADG, lb	**3.52**	**3.52**
Gain:Feed (linear effect)	**0.3**	**0.2**
Steers fed finishing diets		
Fluid Intake, gal/d	**7.1**	**7.1**
ADG, lb	**3.52**	**3.08**
Gain:Feed (linear effect)	**0.19**	**0.15**

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Composition of Energy ETOH Products

Feed	DM %	CP %	Nem, Mcal/cwt	Neg, Mcal/cwt	Ca %	P %	S %
CDS	30-50	18-35	100-125	69-89	0.07	1.8	1.6
Wet DGS	30-35	30-35	100	68	0.05	0.8	0.7
Mod DGS	40-50	30-35	100	68	0.05	0.8	0.7
Dry DGS	90	28-32	100	68	0.04	0.8	0.7

Based on several sources including company literature, National Research Council, and United States-Canadian Tables of Feed Composition.

- Today fat not being extracted from bourbon derived distillers
- Sulphur levels generally lower = lower risk of toxicity from bourbon source

Research Update – Fed Daily Open Troughs

2015 Preliminary Data Dr. Eric Vanzant & Alex Altman

General Considerations

- Fat content can limit feeding rates
    - 3-4% added fat level
    - Ask for feed test (de-oiled or full-fat)
- Moisture levels can potentially limit Dry Matter Intake
- Settling of slop grain particles = Recirculation / Stirring

Acidity concerns

- Slop pH typically ~ 4 = slightly acidic (lactic acid + other VFAs)
- North Carolina research with potato cannery waste (lower pH) = tooth decay, rumen tissue concerns, & lower growth rate
- Longer Slop sits = lower pH potential if residual fermentable substrates
  - POINT – Feed it fresh or BUFFER
- Consider feeding a buffer

Buffers

- Common Buffers include:
  - Calcium Carbonate (limestone)
  - Sodium Bicarbonate
- Alkalizer raise pH
  - Magnesium Oxide
- Consider a 3:1 mixture of Bicarbonate:MagOx
- Feed buffer at rate of 0.25-0.5 lb/hd/d immediately at feeding

Can also add limestone to slop tank on truck

Growing Steers Fed Whole Stillage

	Trial 1			Trial 2		
	Urea	**Urea/SBM**	**Urea/WS**	**Urea**	**Urea/SBM**	**Urea/WS**
ADG, lb/d	2.8	3.0	3.0	2.8	2.8	2.8
DM Intake, lb/d	17.7	18.7	18.9	20.1	20.4	21.2
F:G	6.3	6.3	6.3	7.1	7.3	7.7

Note: Intake of Whole Stillage was ~ 1% BW as-fed or about 1.2 gallons = ~ 0.8 lbs

Effective SBM replacement

Koeln et al., 1984

Limiting Stillage to 3% Fat Supplement Level

Lb Whole Stillage as-fed / gallons as-fed

Intake, lb DM/d	Lb Fat Added	3% Added Fat @ 10% Fat	3% Added Fat @ 15% Fat
14	0.42	60 lb / 6.7 gal	40 lb / 4.4 gal
18	0.54	77 / 8.5	51 / 5.7
22	0.66	94 / 10.5	63 / 7
26	0.78	111 / 12.4	74 / 8.3
30	0.90	128 / 14.3	86 / 9.5

Assumes 7% DM in Whole Stillage
Assumes 9 lb/gal in Whole Stillage

Dry Distillers Grains with 10% Fat
14 lb DMI / 0.42 lb Fat supplement
4.7 lb As-fed DDGS
~ 10:1 Exchange for Stillage : DDGS

General Feeding Recommendations

- Adjust mineral program to high Calcium, no Phos
- Up to 40% of diet DM for low Sulphur product
- Mindful of moisture content of total ration as inclusion rates increase, especially for slop
- Consider handling / storage / transportation expenses

NUTRITIONIST'S POINT OF VIEW

- HIGH quality protein & energy FEEDSTUFFS
- Local advantage for BEEF & ruminant industries
- Can be fed to many classes of ruminants
- Appropriately balance TOTAL diet & LIMIT amount fed

Questions?

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